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Fungi Associated With Post-Harvest Rot of Commonly Consumed Fruits in Sokoto Metropolis, Nigeria

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ABSTRACT

A post-harvest fruits rot caused by microbial organism develops on fruits, vegetables and other plant products between harvesting, processing and consumption. The threat of post-harvest rot influences the way most fruits crop are handled, transportation, storage, processing and marketing. In this study a number of fungi viz., *Alternaria alternata*, *A. citri*, *Aspergillus niger*, *A. flavus*, *Aspergillus* sp., *Cladosporium cladosporioides*, *Fusarium solani*, *Fusarium* sp., *Geotrichum candidum*, *Penicillium* spp., *Phytophthora capsici* and *Rhizopus stolonifer* responsible for postharvest deterioration of fresh fruits were isolated and identified through culture media and microscopic methods. Therefore the accurate identification of the causal agents is essential before appropriate treatment can be made to control the pathogens. There is needed to enlighten the producer, sellers as well as the public on the public health risk on consumption of contaminated fruits by the fungal pathogens.

Key words: Post-harvest, Rot, Fruits and Fungi

INTRODUCTION

Postharvest fruits rots caused by fungi cause significant economic losses worldwide and have been a major challenge to agriculture, health, commerce as well as industries [1] Estimates of production losses in developing countries are hard to evaluate. Postharvest losses of fruit in some African countries have been estimated to reach 50% [2,3] hence minimizing post harvest losses of already produced food is more sustainable than increasing production [4]. Fruits are highly perishable products; the quality is affected by post-harvest handling, transportation, storage and marketing. The improper handling, packaging, storage and transportation may result in colonization of the produce by microorganisms and subsequent decay which changing physiological state of the fruits [5]. Microbial invasion of fruits by fungi, in addition to causing rots may also make them unfit for consumption by producing mycotoxins which are hazardous to humans and animals [6]. Careful post-harvest handling is the major but often neglected step towards offering a greater volume of nutritious food to planet and to prevent loss between harvesting and consumption. An important group of microbial organisms, infecting a wide range of host plants and causing destructive and economically important losses of most fresh fruits and vegetables during production in the field as well as storage and transportation [7].

Fruits losses due to the soilborne fungus like oomycete *Phytophthora capsici* have been well reported [8]. The present work describes the role of fungi in postharvest rot of fresh fruits from Sokoto, Nigeria.

MATERIALS AND METHODS

Study area

Studies were carried out in Sokoto Metropolis of the Sokoto State. The State lies between latitude 13° 3' 49^0N, longitude 5° 14' 89^0E and at an altitude of 272 m above the sea level. It is located in the extreme North Western part of Nigeria. The soil is predominantly ferruginous tropical type, texturally sandy and pH of the soil ranges between 6 and 7. Rainfall starts late from June and ends early, in September. The highest temperatures of 45°C during the hot season are experienced in the months of March and April. Harmattan, a dry cold and dusty condition is experienced between the months of November and February [9,10].

Sample collection

Fresh fruits of guava (*Psidium guajava* L.), mango (*Mangifera indica* L.), melon (*Cucumis melo* L.), lemon (*Citrus limon* (L.) pawpaw (*Carica papaya* L.), pepper (*Capsicum annuum* L.), okra (*Abelmoschus esculentus* L.) and tomato (*Lycopersicon esculentum* Mill.) showing the deterioration and rotting were collected from different markets of Sokoto like Ramin Kura market, Sokoto fish and vegetables market, Marina market, Kofar Rini Market, Gawon Nama and Kanwuri Market. Samples were kept at 4°C until the identification and isolation were made within 48 hours.

Media preparation and inoculation

The media used were Sabouraud Dextrose Agar (SDA) and Potato Dextrose Agar (PDA), they are prepared according to the manufacturers' instruction. Rotten part of fruits and vegetables were surface sterilized with absolute alcohol after which they were cut using a sterile scalpel. Cutting was done at the beginning from the healthy portion (so as to get at area of rot), these were used as inoculums and inoculated into culture media.

Identification

Physical counts of the fungal colonies were made, and averages of the isolation for each set of samples obtained were taken. Isolates were identified based on cultural and microscopic characteristics comparing with the aid of standard mycological texts and manuals of Mycology.

Analysis

Results were analyzed with interactions. The P values and resulting conclusions were similar for all forms of analysis and P value = 0.05. Results were reported only for the untransformed data. Analyses by x^2 (using general linear model procedure) were performed using Minitab for Windows, release 16.2 (Minitab Inc., State College, PA).

RESULTS

Twenty (20) samples each were collected from tomatoes, okra, pepper, mango, orange, guava, papaya, melon, and examined by mycological culture and microscopy. All the samples were hundred percent (100%) positive for at least four (4) or more fungal pathogens.

Aspergillus niger , *A. fumigates* were found present in all the fruits isolated, while *A. flavus*, *R. stolonifer* and *A. alternata* were found to present in seven fruits, *R. stolonifer* and *P. citrinum* was present in six fruits and *M. racemosus* found on only four fruits. The Distribution of fungi on rotten fruits was presented in table 1.

Aspergillus niger occurred more frequently (26.8%), this is then followed by *Rhizopus stolonifer* (20.1%) The least in occurrence were isolates of *Rhizopus stolonifer* and *Mucur racemosus* which only occurred in tomatoes isolates. Other less predominated isolates were isolates of *Alternaria alternate Penicilium citrinum* and *Aspergillus fumigates Fusarium solani*. The occurences of various types of fungal pathogens isolated from plants fruits is presented in table 2. Infected fruits initially show water-soaked lesions and eventually shrivel and rot. The fruits turn white, and the interior of the fruits are heavily colonized by the white mycelium of isolates.

Table 1 Distribution of fungal species isolated from rotten Fruits in Sokoto Metropolis.

Isolate	Guava	Mango	Melon	Lemon	Papaya	Tomato	Okra	Pepper
A. niger	+	+	+	+	+	+	+	+
A. flavus	+	+	+	+	+	+	-	+
A. fumigates	+	+	+	+	+	+	+	+
R. stolonifer	-	+	+	+	+	-	+	+
M. racemosus	+	-	-	+	-	+	+	-
P. citrinum	+	+	+	+	-	+	+	-
A. alternata	+	+	+	+	+	+	-	+
+ = Present								
- = Absent								

Table 2 Occurrence of fungi associated with rotten fruits in Sokoto Metropolis.

Fungi	Number of occurrences
Alternaria altanata	108
Aspergillus flavus	117
Aspergillus niger	137
Aspergillus fumigates	117
Pennicilium citrinum	107
Mucor recemesus	59
Rhizopus stolonifer	98

Chi-Sq = 62.742, DF = 10, P-Value = 0.000. 3 cells with expected counts less than 5

DISCUSSION

The results obtained from this study have indicated that fruits that are commonly consumed in sokoto metropolis are contaminated by fungal agents. Isolates such as (*A. niger, A. fumigatus, A. flavus, R. stolonifer, M. racemosus* and *P. citrinum*) where identified. This is in agreement with the findings [11] who reported several species of Fungal Pathogens found associated with Tomatoes and storage vessel. With *Aspergillus specie* more prevalent, similar fungal isolates were reported [7, 12, and 13] from tomato and vegetables in Sokoto respectively. And finding from this investigation indicates that the aforementioned fungi were associated with deterioration of

fruits. This agrees with the reports of other researchers [14,15] that fungi constitute a menace in the storage of many agricultural commodities including fruits. This could be associated with hygienic conditions of the cultivation site of the fruits. The result obtained is in consonant with the findings [16], who study the vegetable production by waste water, the presence of wide range of fungal organisms in these products showed a relationship between the microbial quality of the water used for the vegetables and the extent of human and other animals defecation, agricultural activities as well as domestics waste discharges in the only river (River Rima) and its' tributaries that is the only source of water for irrigation in the area.

Presence of such fungi in fruits of Sokoto markets indicates that the fungus is present in the fields from where the fruits are coming. The pathogen infects fruits during prolonged periods of heavy rainfall and high humidity, especially when plants are over-crowded or over fertilized with nitrogen [17]. Fruit rot can occur from the time of fruit set until harvest [18]. There is needed to enlighten the producer, sellers as well as the public on the public health risk on consumption of contaminated vegetables by the fungal pathogens. Fresh fruit can be contaminated with a wide range of microbial organisms from the environment. Contamination can occur at different stages of production, during processing and in storage [19]. Similarly, inappropriate handling, packaging at the retail or wholesale outlets may predisposed the vegetables to increased invasion and subsequent contamination by fungal and bacterial species especially under ambient tropical condition typical of marketing site in Sokoto metropolis [20]. However, the difference in the occurrence of the microbial contaminants is a reflection of the genetic and physio-chemical chemical of the different plant species investigated. Fresh produce may be infected by microbial organisms at harvest, the infection may be obvious or latent, and is often associated with poor pre-harvest management such as soil, faeces, irrigation water, fungicide and insecticide handling

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